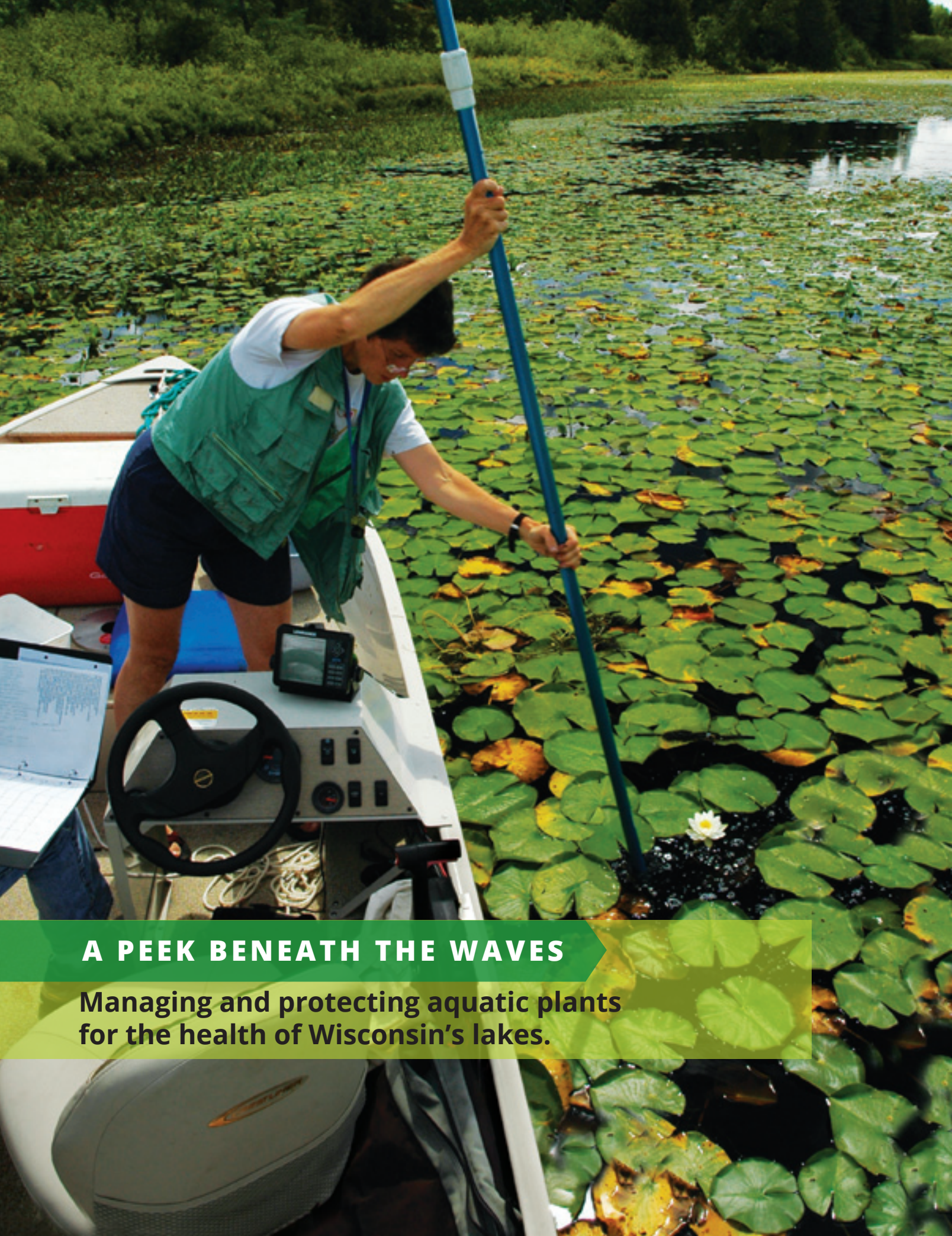


A PEEK BENEATH THE WAVES

Managing and protecting aquatic plants for the health of Wisconsin's lakes.

DNR's aquatic plant management research team has been working to provide sound science to understand the complex relationships between plants and the greater lake ecosystem. Team members include Jen Hauxwell, Kelly Wagner, Alison Mikulyuk, Michelle Nault, Martha Barton and Susan Knight, in addition to many other helping hands over the years.

FRANK KOSHERE

UNDERSTANDING THE UNDERWATER WORLD

A decade of research has led to greater knowledge about our aquatic plant communities and the way we manage them.

Eric Verbeten

Beneath the waves of Wisconsin's 15,000 lakes are a variety of aquatic plants and animals living together in a give-and-take relationship, relying on one another for survival. Understanding this relationship is key to improving and protecting lake health in Wisconsin. DNR scientists have been studying our lakes for years to better understand what it takes to keep a lake healthy.

Challenges are abundant when managing aquatic plants. Wisconsin's lakes differ in their characteristics and lake users have diverse interests. Water quality concerns and potentially dangerous blue-green algae blooms, due in part to excessive nutrients in the water, as well as the introduction of invasive species, can have major impacts on our underwater worlds.

Understanding these challenges has been a priority of the department, and 10 years ago the aquatic plant management research team set out to expand and standardize the way DNR scientists and lake management professionals study and gather data for Wisconsin's lake ecosystems.

Jen Hauxwell is a DNR scientist who leads this team of researchers whose goal is to provide sound science for informing management decisions and to share that knowledge with Wisconsin citizens, visitors and lake associations who are concerned about the health of their lakes.

"When we set out to design an aquatic plant monitoring system, we wanted one that would allow us to collect and analyze a library of information on a variety of lakes," says Hauxwell. "We needed to have consistent, accurate and repeatable measurements that would allow us to understand the complex relationships between aquatic plants in lake ecosystems around the state, as well as the ability to track the status of a single lake over time."

The resulting dataset provides not only a snapshot of a variety of Wisconsin lakes today, but also a clearer understanding of what is happening in lake ecosystems. The team developed a database, which allows researchers to compare how aquatic plant communities relate to numerous factors that affect them, such as water quality (which affects the light plants receive), temperature, precipitation, management

Analyzing plants in the lab is one part of the team's work.

JEN HAUXWELL

actions and how wildlife and fish respond to different aquatic plants.

The last 10 years of research and standardized monitoring have uncovered a wealth of new information about lake plant communities, invasive species such as Eurasian water-milfoil, the effects of shoreline development and more. Today, when groups of lakeshore owners come together to address a problem on their favorite body of water, the DNR is available to provide assistance and consultation to help them make informed decisions.

The initiative to bolster our current knowledge of lakes and aquatic plant ecosystems has three main focus areas: understanding native plants, managing invasive species and providing outreach to communities.

Native plants

In the last 10 years the agency has learned a lot about the importance of native aquatic plants in our lakes. These plants are crucial to having a healthy lake ecosystem — they improve water clarity, prevent erosion and provide habitat and food for a variety of animals and fish.

DNR's aquatic plant management research team has discovered more than 120 new occurrences of rare plant species living in Wisconsin's lakes. These discoveries lend themselves to the greater understanding of the complexities of lake ecosystems as well as the interconnected role each plant plays with other species. By monitoring the health of these plants, researchers are able to use them as a "canary in the coal mine" to understand the overall health of a lake and identify areas that may be at risk.

Invasive species

To date, more than a dozen different species of invasive aquatic and wetland plants like Eurasian water-milfoil, curly-leaf pondweed, purple loosestrife and phragmites have been documented in Wisconsin. Invasives can be harmful to a lake ecosystem in several ways. For example, Eurasian water-milfoil can crowd out other native plants on localized scales, and can sometimes top out at the water's surface, making boating and swimming difficult. Another invasive, curly-leaf pondweed, grows early in the spring, and then rapidly dies back during early- to mid-summer. This rapid decomposition of plant material can cause large nutrient releases into the water, potentially triggering algal blooms and other water quality issues.

The aquatic plant research team's statewide survey of 100 lakes containing Eurasian water-milfoil documented how this invasive species behaves across different lakes. Researchers continue to document the locations of Eurasian water-milfoil and other invasive species in select lakes, and use that information to create detailed maps showing where certain species have taken hold.

Researchers literally dive right into their work, clipboard in tow.

DNR FILE

DNR scientists travel to lakes across the state to sample plants and collect data.

BRIAN EWART

This standardized survey approach has been used as a model to create more than 1,300 lake maps for lake groups and professionals. The department provides these maps to anyone interested in sampling a lake to give them an idea of the types of both native and invasive aquatic plants species present. Lake maps can be found on the DNR Surface Water Integrated Monitoring System (SWIMS).

Outreach

Informing the public of the most current research and data is paramount to the team.

For every type of lake management technique, there are pros and cons to be considered. Whether it is the physical removal of aquatic plants or a chemical treatment for controlling a non-native species, the research efforts of the past 10 years have uncovered a lot of information about the positive and sometimes unintended negative consequences. The department works with lake groups, landowners, volunteers, lake management professionals and all those interested in managing and protecting their lakes by providing the latest scientific information about how lake systems work.

Over the past eight years, the department has also funded and helped coordinate more than a dozen aquatic plant identification workshops around the state where anyone can come and learn how to identify the more than 100 aquatic plant species found in Wisconsin. Susan Knight, a researcher at UW-Madison's Trout Lake Station, is a statewide leader in developing and teaching these workshops and is often assisted by other DNR researchers and managers. Workshops are usually held in June at the Kemp Natural Resources Station near Tomahawk, in April or May at the Wisconsin Lakes Convention, and at various fairs and for student groups. ■

Eric Verbeten is a communications specialist with the DNR's Office of Communications.

PAUL SKAWINSKI

WISCONSIN'S HISTORY OF AQUATIC PLANT MANAGEMENT

How we view and manage aquatic plants has changed significantly over the last 200 years.

Scott Van Egeren and Carroll Schaal

Excessive aquatic plant growth has been an issue for Wisconsin lakes since the 1850s. New human activities on the landscape, such as farming, logging and shoreline construction, increased the amount of nutrients entering the lakes — stimulating plant growth, which was bad for the profitable ice-making business which needed "clean ice." After the decline of the ice trade, a desire for better aesthetics and improved boating and recreating conditions led to additional plant removal.

Many early Wisconsin lake associations formed around the turn of the last century to manage plants, and aquatic plant management continues to be an impetus for lake organization creation today. During the late-1800s and early-1900s most aquatic plant control was accomplished by labor-intensive methods of manually removing the plants.

The development of chemical herbicides created new tools for aquatic plant management and by the mid-1920s chemical herbicides were being used to control nuisance plants. A chemical called sodium arsenite was used to control aquatic plants in swimming areas. Counties, cities and lake associations sponsored treatments to control these "nuisance" plant conditions.

In time though, controversy brewed between sporting groups, who prized plants as habitat and food for waterfowl and fish, and private lakeshore landowners who wanted to control aquatic plants to improve recreation and aesthetics.

As a result of these differing values, Gov. Phillip LaFollette issued an order in 1938 to form an interdepartmental aquatic nuisance control (ANC) committee to review and regulate algae and aquatic plant control in public waters. The ANC committee was part of the larger Committee for Water Pollution Control, which later became part of the Department of Resource Development and then the Department of Natural Resources (DNR).

A shift in herbicides

The ANC committee issued permits for aquatic nuisance control projects and educated sponsoring organizations on both the public benefits and potential ecological consequences of treating a lake with chemicals. A few years later, the Wisconsin Legislature granted the ANC committee the authority to supervise chemical treatments of waters as well as purchase and operate aquatic chemical control equipment, which was even rented to sponsoring organizations as needed. However, the public demand for the equipment grew too large and the state discontinued the rental program in 1949.

Municipalities and lake organizations had originally sponsored large-scale sodium arsenite treatments for the public because the treatments were too costly for individual landowners, required specialized equipment and the chemicals used were too dangerous for untrained individuals to apply.

Between 1950 and 1969 over 2 million pounds of sodium arsenite was applied to 167 Wisconsin lakes. Sodium arsenite was the only herbicide used for aquatic plant control until the 1960s, when it was discovered that much of the chemical remained in the water and lake sediments for extended periods of time and did not break down into harmless by-products. Legacy arsenic can still be found contaminating the sediments of lakes in which the chemical was heavily applied.

Sodium arsenite was phased out by 1970 in favor of biodegradable herbicides such as 2,4-D, endothall and diquat that were often used for control of agricultural weeds. These herbicides (still used for aquatic plant management today), were more expensive than sodium arsenite because they were produced in pellet form, which also made them easy for anyone to apply. The ease-of-use and high cost of the new herbicides largely changed the way herbicides were being used. Instead of large-scale treatments sponsored by municipalities or lake organizations, treatments could be smaller, and more localized treatments could be applied to beaches and dock areas by individual citizens. These herbicides were also readily available in catalogs, making it easy for individuals to purchase and illegally apply the herbicides without a permit.

1850s

Excessive aquatic plant growth first identified as a concern in some Wisconsin lakes

© FAUERBACH BREWERY

Harvesting ice on Lake Monona

1890s

First lake associations formed out of a desire for better aesthetics and recreational conditions

DNR FILE

Aquatic plants on beach

1920s

Chemicals introduced to fight aquatic plants

© B. SALEY

Applying chemical treatments to Lake Monona

1960s

"Silent Spring" published, documenting the effects of pesticides and herbicides on the environment

HOUGHTON MIFFLIN

Eurasian water-milfoil discovered in southern Wisconsin

Sodium arsenite phased out of use

1970s

Federal Insecticide, Fungicide and Rodenticide Act is rewritten giving the Environmental Protection Agency the authority to regulate pesticides for the protection of human health and the environment

Wisconsin Lakes Partnership formed

Invasives introduced

The goal of the ANC program of the 1940s through 1970s was to control aquatic plants for aesthetic and recreational reasons, with little focus on how those effects would fit into the overall health of the lake ecosystem. The plants that were controlled through the 1970s under this program were often native aquatic plants, but this would soon change.

Invasive plants like Eurasian water-milfoil (EWM) were discovered in several lakes in southern Wisconsin in the mid-1960s, and by the 1970s had become a major concern for Wisconsin lake managers. This invasion drastically changed the ANC program over the next several decades. In addition, the public was becoming increasingly concerned with the use of pesticides and herbicides following the publication of Rachel Carson's book "Silent Spring" in 1962 and subsequent popular interest in the environmental movement.

The role of aquatic plants in a healthy lake ecosystem was increasingly studied by scientists, and the benefits aquatic plants provide to lakes were advocated for by sporting groups in the 1970s and 1980s. About this time, the Department of Natural Resources and University of Wisconsin-Extension joined with the Wisconsin Association of Lakes to form the Wisconsin Lakes Partnership. The department provided technical and financial assistance while UW-Extension provided education and outreach to newly-formed lake organizations for aquatic plant management activities, with the emphasis on long-term benefits beyond seasonal nuisance plant reductions.

The ANC program was increasingly criticized for destroying aquatic plant habitat and the department was asked to conduct an environmental assessment of the ANC program in 1988. Aquatic nuisance control began shifting back to lake-wide aquatic plant management, but now the aim was to integrate this approach with other holistic lake management activities. For example, the department recognized that nutrient reduction and runoff management were needed to control the root cause of excessive aquatic plants and algae.

In the early 1990s, EWM was found in northern Wisconsin and fear rose about the impact the species could have on tourism for the many pristine lakes of the north. Quickly, an emphasis was placed on preventing the spread of EWM to new lakes and to contain populations in the lakes where it already existed.

Over the next two decades aquatic invasive species prevention became an important management goal, starting with the Clean Boats, Clean Waters watercraft inspection program and the Citizen Lake Monitoring Network. Scientists also studied additional methods of controlling EWM, including manual removal, lake bottom barriers and the introduction of EWM-eating insects known as bio-control weevils.

Integrated aquatic plant management

The 2001-2002 Wisconsin Legislature increased the DNR's authority to issue permits for management methods other than chemical treatments, including mechanical, manual and biological control activities, and the ability to require that an Aquatic Plant Management Plan be in place for lakes before permits are issued.

The DNR and partners have been conducting statewide research since the mid-2000s to study the impacts of lake-wide and localized herbicide treatments for invasive species control. These studies have shown the complexity of how herbicides move within a lake and the range of their effectiveness as a management technique. Aquatic plant and herbicide data collection has helped to hone appropriate treatment strategies and understand the potential dangers to non-target organisms.

These studies have allowed for the development of best management practices for invasive species control. For instance, treating early in the season when the invasive plants are growing, but most native plants have not yet emerged, poses a lower risk of damaging native plant species.

Although recent research has vastly improved the state's collective knowledge of aquatic plant management, there are still challenges and emerging issues. For example, certain strains of EWM have hybridized with native water-milfoil, and some hybrids appear to be more tolerant to commonly used herbicides. Chemical control of EWM has also been shown to be more difficult to implement on smaller plant beds because the herbicides will rapidly dissipate away from the target area.

Today, the Wisconsin Department of Natural Resources is recognized as a national leader in the research and demonstration of aquatic plant management techniques, and is committed to working with the Wisconsin Lakes Partnership, lake organizations, landowners, recreationists and aquatic plant professionals to update and improve aquatic plant management and protection in the state.

The main control methods used today are still chemical (herbicides) and mechanical, though manual hand-pulling or SCUBA-assisted removal is becoming more common for smaller, localized sites. Bio-control (the stocking of plant-eating insects) is also gaining consideration.

Millions of dollars are spent annually throughout the state on invasive and nuisance aquatic species management. Through better communication, information sharing and resources coordination, together we will learn how aquatic plants and people can better coexist for the future health and sustainability of our lakes. ■

Scott Van Egeren is DNR's statewide Lake and Reservoir Ecologist.

Carroll Schaal is the DNR's Lakes and Rivers Section Chief in the Bureau of Water Quality.

1980s

Citizen Lake Monitoring Network begins

1990s

Eurasian water-milfoil discovered in northern Wisconsin

FRANK KOSHERE

Eurasian water-milfoil

2000s

"Clean Boats, Clean Waters" watercraft inspection program created

FRANK KOSHERE

Bobber in EWM

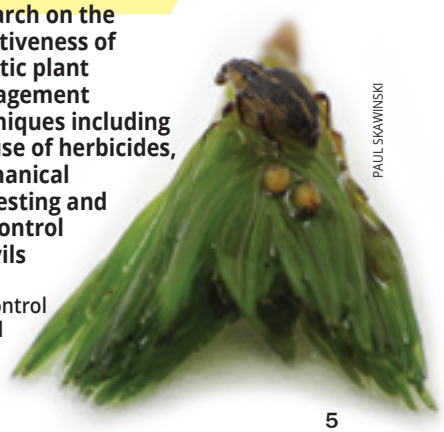
DNR begins new effort to develop an aquatic plant monitoring system

FRANK KOSHERE

Mapping with GPS

Today

DNR continues research on the effectiveness of aquatic plant management techniques including the use of herbicides, mechanical harvesting and bio-control weevils



PAUL SKAWINSKI

Bio-control weevil

Light streams through the water to the lake bed below. Just like plants on land, aquatic plants must gather sunlight, absorb carbon and collect nutrients in order to photosynthesize, grow and reproduce.

PAUL SKAWINSKI

THE (PLANT) LIFE AQUATIC

Living underwater is as amazing and complex as life on land.

Susan Knight

The shallow area near a lakeshore, with its complex communities of plants and animals, is the cradle of life in fresh water. The aquatic plants found growing near shore are critical to the structure and function of the water body.

Though often considered a nuisance, aquatic plants play a vital role in protecting and nourishing the near-shore community. While their understated beauty may be an acquired taste, the importance of aquatic plants to the lake ecosystem is undisputed.

Underwater plants are a home, safe haven, nursery and bountiful buffet for the diverse parade of creatures that need water for life, and make living near the water worthwhile for us. Depending on their form and location near the shore, aquatic plants may be emergent (where most of the plant is out of the water), floating (usually with roots planted in the lake bottom) or submersed (completely underwater).

Emergent plants, like cattails, bulrush or sedges, secure the lake perimeter, anchoring sediments along the wave-swept shoreline. When they are maintained in a strip or buffer along the shoreline, they help slow rainwater — laden with sediment and excessive nutrients — from running into the lake.

Floating-leaved plants, such as lily pads, grow deeper than emergent plants and have leaves that float on the surface, gathering sunlight and air like floating solar panel snorkels. They provide shade and help calm the waters for near-shore residents like fish.

Submersed plants, like pondweeds, grow deepest into the water, but they still require sunlight and their growth is limited mainly by water clarity. Submersed plants provide a diverse and rich underwater garden — which becomes a shelter and food supply for a lake's many inhabitants.

While emergent and floating-leaved aquatic plants have relatively easy access to many of the resources necessary for survival, submersed plants face special challenges in living underwater. Just like their landlubber relatives, submersed plants must absorb carbon, gather light and collect nutrients in order to photosynthesize, grow and reproduce. Almost all aquatic plants are flowering plants, and first learned to live on land before they later adapted to life underwater. Many of the adaptations displayed by aquatic plants are traits specifically selected for surviving in a submersed life.

Light and nutrients

Plants with floating leaves have an advantage over other aquatic plants as they have more access to light — another limited commodity for plants living underwater. Like plants in any community, aquatic plants can be shaded by others overtopping them. The two most common and most successful submersed aquatic invasive plant species in Wisconsin, Eurasian water-milfoil and curly-leaf pondweed, are successful in part because they overtop native plants very early in the season — gaining a head start and cutting off much of the light to the native plants growing below them.

Water also makes plants buoyant and eliminates the need for stiff supporting structures like stems or woody trunks, which allows many aquatic plants to grow very quickly, racing toward the light-saturated waters near the surface.

Just as they need light and carbon, aquatic plants also need nutrients such as phosphorus and nitrogen to grow and reproduce. Most aquatic plants are rooted in the lake or stream bottom, and many of them rely on their roots to take up nutrients from the sediments. Some plants also absorb dissolved nutrients directly through their leaves.

Amidst all of this competition, a few

aquatic plants like bladderworts, have adopted a carnivorous diet as a means to supply nutrients. Bladderworts do not have roots and acquire most of their nutrients by capturing tiny invertebrates with small sac-like traps attached to the leaves. These traps, or bladders, fire in a fraction of a second, sucking in unwitting prey that have tripped the trigger hairs. The captured animals die and decompose, and the resulting nutritious soup gets absorbed and consumed by the plant.

As with any plant community, plentiful nutrients generally mean plentiful plants. However, there is a twist to the story when talking about underwater plants. Most submersed plants have at least a bit of a biofilm, or scum, which sticks on their leaves and is made up of algae called "periphyton." The attached algae use the plants as scaffolding and the natural flow of water as their nutrient source, absorbing at least some of the nutrients as they drift by — nutrients that might otherwise supply free-floating algae in the water.

This is a balancing act for the light-hungry aquatic plants; although the attached algae shade the plants somewhat, the algae also help maintain clearer water, allowing more sunlight to reach greater depths. However, if water column nutrients become too abundant, the algae will run rampant, turning the water into something resembling pea soup. The algae may even become so dense that they eclipse aquatic plants to the point of starvation.

Reproduction

Another underwater difficulty for aquatic plants is sexual reproduction, which is necessary for increasing genetic diversity and plant dispersal. Almost all aquatic plants are flowering plants, meaning they produce flowers, fruits and seeds. Plants must find a way to exchange pollen in order to fertilize their flowers during reproduction. On land, pollinators usually provide this service, and given their ancestral connections to land, most of these otherwise submersed plants hold their flowers up in the air to await wind or insect pollination.

Some pondweeds produce floating leaves that aid in gathering carbon and light and may serve as a support raft for an emergent flower stalk. Wild celery plants release a male flower that bobs on the surface until it collides with and pollinates a female flower, which is tethered to the parent plant in the depths below. Bladderworts hold their showy yellow or purple flowers above the water surface, attracting bumblebee pollinators.

A few species, such as slender naiad and coontail, have underwater flowers and rely on flowing waters to carry pollen from one plant to another. Though only a few aquatic plants have showy or fragrant flowers, the fruits and seeds of many species are prized as food by waterfowl and other animals.

Though seeds are an important means of reproduction, aquatic plants largely rely on asexual (clonal) growth for dispersal and survival from one season to the next. Many species, such as wild celery and large-leaf pondweed, use runners to send out new shoots. Others, such as the invasive Eurasian water-milfoil, can fragment and grow into new plants. Many plants, including some pondweeds and bladderworts, produce vegetative buds called "turions" in late summer. These turions lie dormant through the winter and then sprout into new plants in the spring.

All of the diverse aquatic plant species in Wisconsin have different solutions to the challenges of living underwater. Each species is uniquely designed to help them survive and compete for their place in the ecosystem. While each lake has a few common species, a healthy lake plant community has dozens living together. This assortment of plants, with their varied architectures, provides a complex home and food source for countless other aquatic neighbors. ■

Susan Knight is a botanist and aquatic plant specialist working out of the University of Wisconsin-Madison Trout Lake Station.

FRANK KOSHERE

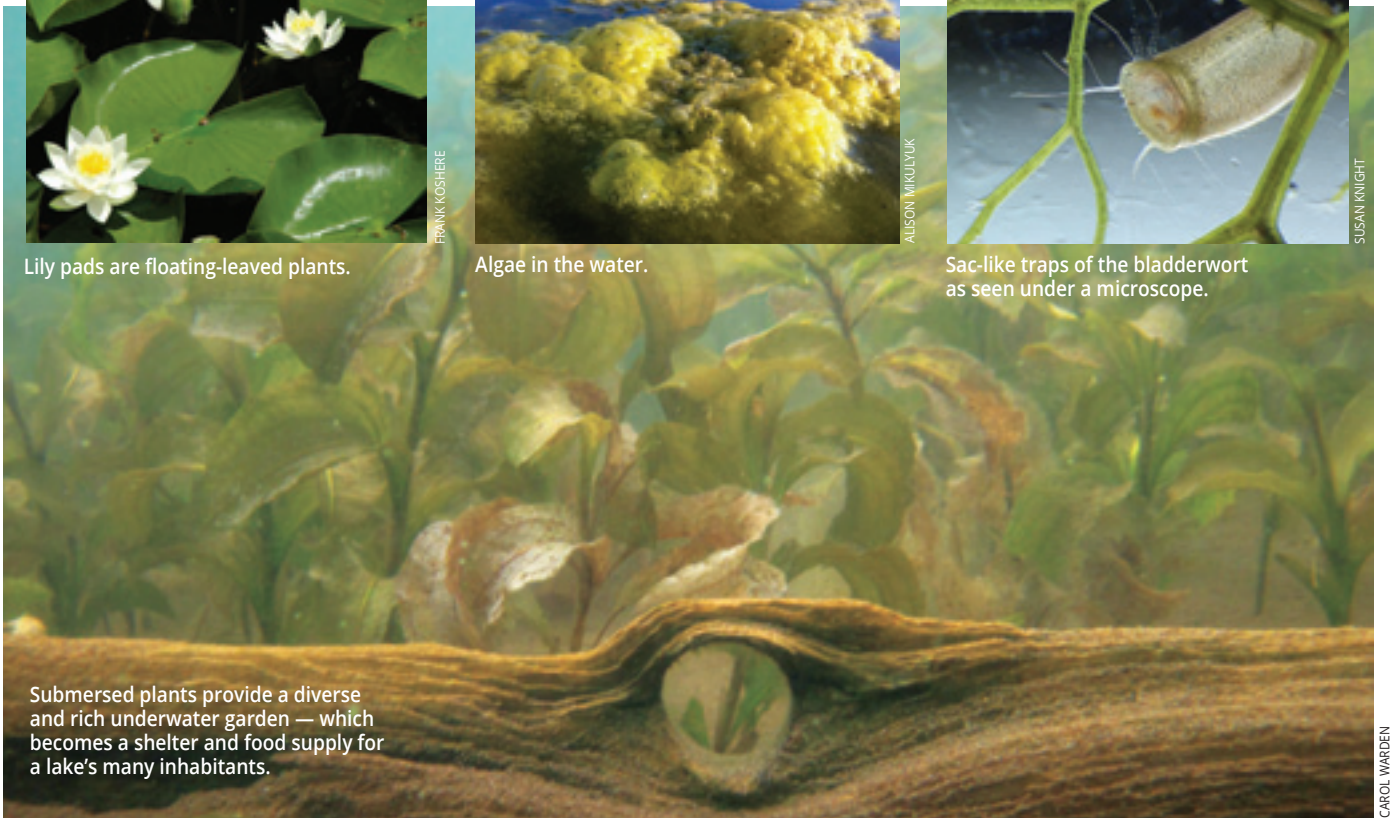
Lily pads are floating-leaved plants.

ALISON MIKULYUK

Algae in the water.

SUSAN KNIGHT

Sac-like traps of the bladderwort as seen under a microscope.



Submersed plants provide a diverse and rich underwater garden — which becomes a shelter and food supply for a lake's many inhabitants.

CAROL WARDEN

Aquatic plants help keep the lake bottom in place, reduce the amount of sediment that is swept into the water and provide essential habitat for other lake dwellers like fish.

ANCHORS OF THE LAKE

Aquatic plants are essential to the health of the lake ecosystem — in mo

Kelly Wagner

Aquatic plants come in a variety of shapes and sizes: some sit quietly on the lake bottom, while others reach above the water's surface to take in additional sunlight. Together, this mix of plants offers a range of benefits for everything in the lake, from improving water clarity and controlling erosion, to providing food and habitat for insects, animals and fish.

One of the main ways aquatic plants help support life in a lake is through their root systems which act like anchors, helping to keep the lake bottom in place. Each time a wave moves toward the shore, the plants slow the water and deflect energy from the wave to help keep the shoreline from eroding. These calm water areas are a focal point for lake health because they help start a chain of events useful for everything in the lake ecosystem, from microscopic algae to top predators like musky.

An aquatic plant's role as an anchor begins by reducing the amount of sediment being swept into the water and later carried downstream or to another part of the lake. But it doesn't end there. When plants slow water movement, they allow sediment and other debris in the water column to settle to the bottom. Here, those wayward bits of debris will be broken down into nutrients, mainly nitrogen and phosphorus, which will be used by the plants as food to grow.

© USFWS

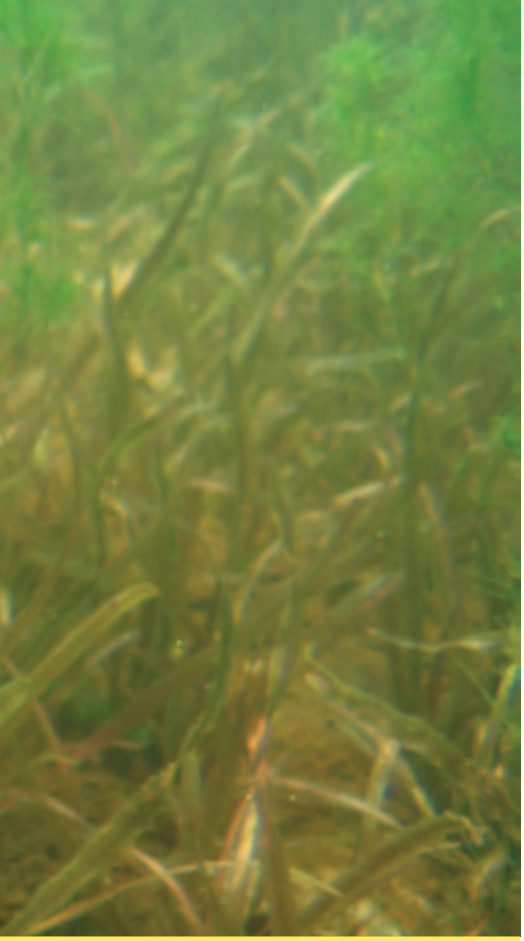
Turtles rely on the lake ecosystem for food.

When plants finish growing and ultimately die, they begin to decay and pieces of the once vibrant plants will float in the water column and eventually fall to the lake bottom. This recycling of nutrients is not only important to replenishing plant life, but also to the rest of the organisms in the lake that rely on these fundamental building blocks of life.

Insects like moths have larvae that feed on aquatic plants, as do caddisflies, and even some grasshoppers. Turtles and crayfish will also eat plants, and even bluegills will eat the leaves and stems of aquatic plants. Beavers chew not only on trees, but also on aquatic plants like sedges, water lilies and pondweeds. Even large land-dwelling mammals like deer, elk and moose will venture to the water for a meal.

Some water birds are dependent upon aquatic vegetation. This is evident in the names of aquatic plants like duck weed, duck potato, watermeal and wild celery. The wild celery plant, unrelated to the grocery store variety, happens to be favored by canvasback ducks. Part of the scientific name for the duck, *Aythya valisineria*, comes from the scientific name of wild celery *(Vallisneria)*. Wild celery is so important to canvasback ducks that restoration of the canvasback duck population on the upper Mississippi River relies on the restoration of this key aquatic plant.

Besides being a food source, some animals will use spongy, buoyant and waterproof plants to build nests. Loons, other water birds and muskrats favor emergent plants that stick up out of the water for this purpose. The strategy is especially useful because the nest will float with the rising and falling of lake levels. In addition, the nest is built right in the near shore area, where there is plenty of food and cover for young fledglings.



BOB KORTH

re ways than one.

SUSAN KNIGHT

Wild celery plant
(Vallisneria americana)

PAUL SKAWINSKI

Insects, like the giant water bug, will lay their eggs among aquatic vegetation.

FRANK KOSHERE

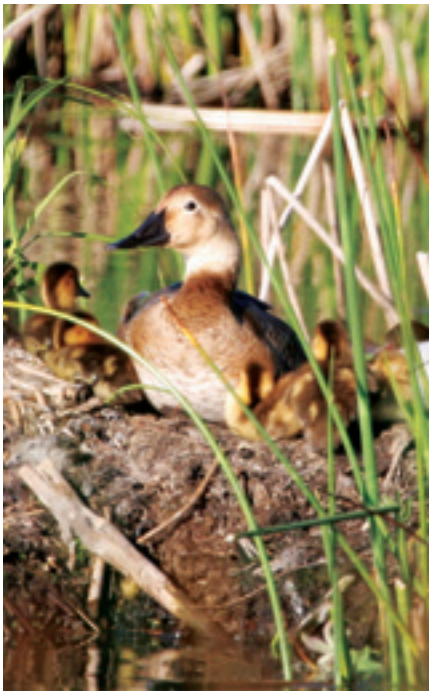
Frogs will dart into plants to escape predators.

Many other lake-dwellers call aquatic vegetation home. Filter-feeding insects sift the water and pull algae out of the water column. There are also grazing insects, such as snails, that scrape algae off of plants, helping the plants absorb more sunlight. Tall, leafy plants provide hiding spots from predators. Frogs will dart into plants to escape the beak of a heron or the jaws of a pike. And, of course, there are fish.

The shapes and sizes of aquatic plants affect their ability to hide fish. Bass for example, need to eat smaller fish to grow, and have a harder time catching fish that feed in the finely divided leaves and highly branched stems of species such as non-native Eurasian water-milfoil than those that are in the more open architecture of native pondweeds. Pondweeds (often referred to as musky weed, cabbage or bass weed by anglers), are prized for their indication of good fishing habitat.

Often, it is the amount and type of plant cover — the percentage of the lake bottom that is covered by plants — that is most important to fish, rather than the particular species of plants. Researchers have been trying for many years to zero in on the optimal amount of plant cover for fish, but different plant habitats favor different types of fish.

Many popular game fish, such as bluegill and largemouth bass, reach their largest sizes in areas of moderate plant cover. A lake with very dense plants is less desirable for predator fish — their growth can be slower in the densely-vegetated lakes where the cover impedes their ability to find and capture prey. Sparse plant cover is associated with several small non-game fish, as well as populations of rough fish, like carp.



© USFWS

Many water birds, such as the canvasback duck, will build their nests among aquatic plants where there is cover for young fledglings.

Plants are also important to the success of fish reproduction. Bass and bluegill build their nests among vegetation, which shelters the nest and provides cover for the young fish once they hatch. Many species, including northern pike, musky and yellow perch, spawn within areas of aquatic vegetation, depositing their eggs either on or among low-growing plants. The young and vulnerable fish of most species will also take refuge in plants.

In addition to food, refuge and spawning, aquatic plants provide underwater animals with something else they need: oxygen. Some oxygen enters the water from the air, but much of the dissolved oxygen in lakes is produced by either aquatic plants or algae as a byproduct of photosynthesis.

When aquatic plants are in a healthy balance, they offer an essential give-and-take relationship to the lake ecosystem — providing habitat for fish and animals, while maintaining clear water and making our lakes the scenic and desirable places to be year-round. ■

Kelly Wagner is a DNR scientist and conducts research on aquatic ecology and invasive species in Wisconsin lakes.

MANAGING AQUATIC PLANTS: DIFFERENT VALUES. DIFFERENT ATTITUDES.

So often we want our lakes to be everything to everyone, but not all lakes are created equal.

Carroll Schaal

People's attitudes about lake plants reflect their different interests. Swimmers going to a lake to enjoy a cool dip may find brushing up against aquatic plants unappealing. Lakeshore property owners often curse the plants around their dock, as do motor boaters and water skiers if they tangle with plant mats in open water. Kayakers and other silent sport boating types may look for wildlife and take delight in the varied forms of underwater vegetation. The best anglers know the sweet spot is between a dense plant bed and deeper open water, and hunters know wild rice is where the ducks hang out.

Lakes differ too, and those differences are reflected in the kind of plant communities they naturally support.

Deep, clear lakes with few nutrients have fewer and smaller plants. These lakes are ideal for many people, offering a "swimming pool effect" where swimmers and divers can see all the way to the bottom and boaters don't get caught in the plants.

Millponds and reservoirs tend to have more plant growth than natural lakes because they are often shallow and have larger watersheds which contribute more sediments and nutrients. Millponds and reservoirs are also more prone to invasion by non-native species due to these conditions.

All lakes are different. The DNR assists lake organizations with developing and implementing Aquatic Plant Management Plans to understand these differences and balance the lake's potential with people's expectations for recreation.

© RJ & LINDA MILLER

Natural lakes that are completely or mostly shallow are inherently full of plant life. Generally, lakes with depths of only 15 feet or less will have extensive plant growth throughout the lake. These lakes are often great for fishing and waterfowl hunting, but not so much for high-speed boating or skiing.

If the lake bottom is mucky and exposed to sunlight, rooted plants will grow — sometimes shore-to-shore — if the right species and conditions are present.

As a general rule, lakes in the southern part of the state have more excessive aquatic plant growth problems than those in the north due to a longer growing season and higher nutrient levels — the result of a long history of watershed disturbance. Also, due to European settlement

Waterfowl need aquatic plants for habitat.

DNR FILE

Management and protection of aquatic plants, the lake and its watershed are important to having a healthy lake ecosystem, as well as providing safe water quality conditions for humans and pets.

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Healthy, natural fisheries rely on a vibrant aquatic plant community.

DNR FILE

and recreation patterns, southern Wisconsin lakes were colonized much earlier by non-native invasive species like Eurasian water-milfoil.

Making decisions, considering values and managing expectations

Choosing what to do with excessive aquatic plant growth and how to do it comes back to societal values, user expectations, the lake's natural conditions and the type of plant community the waterbody is able to support.

Property owners and lake users often are not satisfied with a lake's natural plant community and want to change or "manage" it. It's typically not just the presence of plants that creates issues, it is when those plants grow thick and high in the water and interfere with recreational activity that people take notice.

Less disturbed, low-nutrient waters tend to have lower-growing plant species. As more development occurs on a lake, these species are replaced by taller, more disturbance-tolerant species, thus creating a potential conflict with recreationists. Many lake organizations get stuck in a costly, often escalating annual cycle of battling lake plants to maintain open water or out of fear that an invasive species will take over the lake.

When it comes to aquatic plant management there needs to be reasonable expectations and careful considerations. Not very many lakes are capable of being a swimming pool.

What can go wrong if lake plants are managed incorrectly? When rooted plants are removed, a void is created and more aggressive and tolerant invasive species may replace those removed. In addition, depending on how many plants are removed and the nutrients present, the algae that used to be attached to the surface of those plants will be replaced with free-floating algal species, turning formerly clear water "pea-soup" green and possibly toxic. Zooplankton, barely visible invertebrates that feed on floating algae helping to keep it in check, seek refuge from predators among rooted plants. As plants decline so do zooplankton, potentially compounding algae problems. Fisheries may decline or change with these associated changes in water quality.

Many game fish spawn on aquatic plants and then use their shelter as nurseries shielding them from predators. Non-game species like carp do very well in lakes with no plants.

Aquatic Plant Management Plans

Most native water plants don't need to be managed — they do quite fine without our assistance. When plant growth gets out of hand, the first step for a property owner can be to selectively hand-pull the nuisance plants. Manual removal of any plant within a single 30-foot wide access area around docks can be done without a permit and invasive species can be hand-pulled anywhere. If the plant problem grows, mechanical or chemical control may be needed. On some lakes, aquatic plant management can become almost a full-time effort. When plant management actions have a lake-wide effect — that is when a holistic lake management plan is most needed.

Wisconsin state laws and administrative rules seek to protect a balanced and diverse aquatic plant community while minimizing the impacts of non-native invasive species that threaten to change lake ecosystems and allow for the reasonable control of "nuisance" conditions that inhibit recreational uses. Wisconsin law allows the Department of Natural Resources to require and develop Aquatic Plant Management Plans for lakes before issuing permits.

The DNR assists lake management organizations with developing and implementing Aquatic Plant Management Plans through grants and technical assistance. Education and outreach is also available through programs like Clean Boats, Clean Waters and the Citizen Lake Monitoring Network to help educate citizens, boaters and others on how to recognize and prevent the spread of invasive plants.

The DNR encourages lake communities to work together to set thoughtful and reasonable goals, using both the natural and social sciences to understand and balance the lake's potential and limitations with people's expectations for recreation. This includes careful consideration of all available management techniques, costs and long-term impacts to lake health.

A good plan will be written with input from a diverse group of people and include information on the aquatic plant community present in the lake. A lake's ecosystem can be very different from the expectations of its users. Each plan should be unique to the specific lake and yet be flexible to address changes in conditions of the lake and expectations over time.

After implementation, a thorough evaluation of management activities is needed to determine if all goals are being met. Failure to do an evaluation can create a cycle of continuous management that doesn't work or does more harm than good.

Aquatic plants are an important resource and fundamental to the ecological health of our waterways. With the help of lake organizations, property owners and individual recreationists, the DNR aims to maintain its long-standing mission to balance the environmental, recreational, social and economic needs of all of Wisconsin's lakes users — not always an easy task as different people like to enjoy the lakes in their own way. ■

Carroll Schaal is the DNR's Lakes and Rivers Section Chief in the Bureau of Water Quality where he has worked for 20 years with the Wisconsin Lakes Partnership.

A SCUBA diver uses a hydraulic harvester to uproot and remove Eurasian water-milfoil plants.

SUBMITTED BY CHUCK DRUCKREY

PARTNERING FOR HEALTHY LAKES

Pulling out all the stops to manage a Wisconsin lake invader.

Lisa Gaumnitz

In Oneida County's Squash Lake, SCUBA divers working from ice-out to ice-in, five days a week to remove Eurasian water-milfoil (EWM) by hand have substantially reduced the amount of the invasive plant in the lake.

"A lot of people are beside themselves because they have Eurasian water-milfoil," says Stephanie Boismenue, the lead volunteer behind the effort. "But it can be reduced and managed."

In Pewaukee Lake in Waukesha County, the sanitary district runs mechanical harvesters daily to cut EWM, but also purchases land containing wetlands, restores prairies and stabilizes shorelines to reduce erosion and trap excess nutrients that can fuel plant growth.

"To fix a problem, you need to go to the source of the problem," says Lake Pewaukee sanitary district manager Tom Koepp.

And in Price County, a 6-foot drawdown of Lac Sault Dore, a 561-acre impoundment, was extended to freeze out and control EWM plants, providing dramatic, positive results for the lake.

"When you knock back 99.3 percent of it and still retain most of the (native) aquatic plants, we would have to consider it a success," says Stan Gruszka, the lake association president.

A growing number of Wisconsin lake associations, sanitary districts and other caretakers of the state's freshwater gems are successfully reducing EWM while protecting native aquatic plant communities. They're using a growing suite of tools — a strategy called integrated aquatic plant management — to make sure the right tool is used at the right place and at the right time.

Chemical treatment

Chemical treatment has historically been the go-to tool when EWM is found in a lake. Today it is still the most common management strategy with 301 permits for lake treatments approved in 2013.

Chemical treatments can range in price from hundreds to thousands of dollars per acre. As the costs of annual chemical treatments add up, and the data collected regarding the short- and long-term effectiveness of such treatments has shown mixed results, numerous lake groups and the DNR — which typically share the costs of the treatments, are considering alternatives.

A decade of research by the Department of Natural Resources, the U.S. Army Corps of Engineers and the University of Wisconsin-Extension, is shedding light on how to increase the effectiveness of chemical treatments as well as what some of the limitations and drawbacks are for using chemicals in lakes.

Ongoing research has shown that certain chemical treatments may affect non-target plant species and aquatic life, and that repeated treatments may also result in the invasive plants developing a tolerance to certain chemicals, or encourage the growth of even more aggressive hybrid plants over time. Collaborative research in Wisconsin has also shown that many of the small-scale chemical treatments so widely used now, in which high doses of liquid or granular herbicides are applied to small target areas, are not performing as once hoped. In many cases the chemicals rapidly dilute and immediately dissipate, and concentrations of the chemicals do not remain high enough to

BOB KORTH

Volunteers with the Citizen Lake Monitoring Network help collect data for lake chemistry, temperature, dissolved oxygen and water quality, identify and map plants, and also watch for the appearance of Eurasian water-milfoil.

FRANK KOSHERE

Loading herbicides into a boat to be applied to a lake to help control Eurasian water-milfoil.

ANDY SCHATSCHNEIDER

Nate Rice holds one of the many garbage cans full of Eurasian water-milfoil that SCUBA divers and kayakers removed by hand on Silver Lake in Waukesha County.

ONEIDA COUNTY SQUASH LAKE ASSOCIATION

Stephanie Boismenue uses an aqua scope to monitor for Eurasian water-milfoil on Squash Lake in Oneida County.

effectively kill the target plants.

At the same time, the growing track record of EWM in Wisconsin suggests that the plant does not necessarily become widespread or as problematic in all of the lakes it invades.

"Eurasian water-milfoil isn't always gloom and doom for a lake," explains Carroll Schaal, who leads the DNR's lakes and rivers program. "In most lakes with EWM, it's only 10 percent or less of the overall plant community."

The plant was first detected in southern Wisconsin in the 1960s. It spread to other southern and central Wisconsin waters and in many cases became prolific, flourishing in the soft, mucky bottoms and forming dense mats at the water's surface that ensnarled swimmers and boat propellers, hampered fishing and shaded out beneficial native plants.

In more recent years, EWM has invaded several northern Wisconsin lakes, but the shorter growing season, sandy lake beds and lower nutrient levels appear to have limited the spread, as have communities mobilizing to prevent the invader from entering their lakes.

Many associations participate in invasive species training through the state's Clean Boats, Clean Waters program. This program has helped build a network of volunteers who educate boaters and anglers on invasive species prevention steps. Volunteers interested in lake science can also participate in the Citizen Lake Monitoring Network. The citizen scientists in this program keep a close eye on their lakes to allow for a rapid response if invaders are discovered.

"A lot of how we respond depends on the lake," says Jim Kreitlow, a DNR lakes management specialist in northern Wisconsin. "It's not a one-size fits all."

If Eurasian water-milfoil is at a low level in the lake, "we might leave it alone for a while because it may not get any worse than it is now," he says. "If it's out of control, perhaps we do a whole lake treatment with the chemicals at a lower concentration. We need to pick and choose where we use chemical treatment and perhaps look at some other tools."

Hand-pulling

Stephanie Boismenue had been looking for EWM in Squash Lake for about five years when she spied two fragments wrapped around her dock in the summer of 2009.

"I said, oh darn, please don't let this be what I think it is," says Boismenue, leader of the Squash Lake Association invasives committee. But it was, and was found to cover about seven of the lake's 400 acres.

When the consultant who the group hired recommended using 2,4-D in spring

FRANK KOSHERE

A volunteer holds a Eurasian water-milfoil plant pulled from the water.

PAUL SKAWINSKI

A close-up of the Eurasian water-milfoil plant as it reaches to the water's surface near the lakeshore. Lake associations and others are successfully reducing EWM populations while protecting native plants by using a suite of tools — a strategy called integrated aquatic plant management.

2010 on the scattered clumps of EWM, the group decided to take a step back.

"Because the treatment wasn't going to be until the following spring, we had time to dig our teeth into what we really wanted to do," Boismenue says. "We wanted the best for our lake. It's healthy and well-balanced and we wanted to preserve that."

Lake association members searched for information to see how lakes treated 20 years ago were faring today, not just in terms of Eurasian water-milfoil, but for their water quality, whether lake bed sediments contained chemicals used during the treatment, the health of frogs and other aquatic creatures living in the lake and the health of people living around the lakes.

They found few answers. "Until we knew for sure, we decided we were going to find another route," she says.

The association discovered they could get SCUBA divers to hand-pull the plant. They hired three people to hand-pull that first summer and are now up to eight divers, many of them recruited from local dive and rescue teams and paid through DNR grants. Boismenue coordinates the effort and stays on top of the water in a boat, collecting the bags of invasive plants handed to her by the divers and changing out oxygen tanks.

She also coordinates a crew of mostly lake residents to keep a close watch for new growth so she can get divers on any new sites immediately.

The first two years of hand-pulling resulted in the biggest reduction; now the divers work to reduce the number of clumps on the lake's north end.

"I have to keep reminding everybody on this lake, we're never going to get rid of it — it's the nature of the beast," she says. "But there is hope."

Drawdown

Eurasian water-milfoil was first spotted in Lac Sault Dore — a.k.a. Soo Lake — in Price County in 2006. By 2009, it covered 200 acres.

"It was tough to boat, tough to fish," recalls Stan Gruszka, president of the Soo Lake United Association. "We had too many fish competing for the same food, too many hiding places."

The association got a DNR lakes planning grant to evaluate options and design a plan. Their consultant concluded the lake wasn't a good candidate for chemical treatment because the connecting Elk River would carry the chemical away before it could act. Mechanical harvesting also wasn't a viable option due to the lake's shallow depth and woody bottom. But as luck would have it, a drawdown was scheduled to allow dam repairs. The group asked to extend the drawdown through the winter with hopes of freezing or drying out the invasive plants and killing them. It worked. The drawdown eliminated nearly all of the invasives that year.

"It didn't really impact the native plants but did kill some smaller bluegills," explains Gruszka.

When some re-growth occurred, Phillips High School students joined association members to hand-pull the invasive plant. The association is now asking the county to re-write the dam's operating orders so that if the lake has to be drawn down again, it can be to the 6-foot level — the mark which produced the best results for killing the invasive plants.

"Our membership supports this request," Gruszka says. "Most of us would like to avoid drawing down the lake; it's a tool of last resort. Hand-pulling and some possible chemical control in isolated areas might be possible, but our big stick is the drawdown.

"My advice to other lakes battling Eurasian water-milfoil is that there is no silver bullet treatment. Each lake is different and they [the associations] have to go through the process of exploring what is best for their lake," he says.

Early detection and a one-two punch

Chemical treatment was one of the right tools for Little Newton Lake in Marinette County. When EWM was first discovered, it was limited to a few dense colonies that totaled less than two acres.

"We used early season 2,4-D treatments to control the larger beds. Good seasonal control was achieved and we followed up with hand-pulling," says Chuck Druckrey, Marinette County water resource specialist. "The main site required a second herbicide treatment and at one point we found additional sites that were treated as well."

Druckrey says the Little Newton Lake experience was a good lesson on the benefits of early detection and adaptive management to control EWM before it becomes widespread.

"My advice to others is to use all the tools that are available (and appropriate) and keep at it," he says.

Scott Provost, the DNR's statewide aquatic plant management coordinator agrees.

"Using various tools is not only common sense, it has become part of the legal framework behind permit decisions, says

Provost. "Using all the tools available, such as manual and mechanical removal in combination with other methods, is what is meant by Integrated Pest Management (IPM), which is required to be part of the DNR's permit process."

Federal law, through the Clean Water Act, requires permits for activities that discharge chemicals to surface waters because these activities can have substantial impacts on humans and the environment. Wisconsin has responded by allowing lake groups or individuals to apply for a Wisconsin Pollutant Discharge Elimination System general permit.

One of the criteria for a successful permit application is that the person or group applying must evaluate and implement IPM for their lake.

"Utilizing IPM helps minimize discharge of excess biological or chemical agents while maintaining federal water quality standards and encouraging effective management decisions that weigh the costs and benefits of all management options," explains Provost.

A long-term approach

Such persistence and adaptive management strategies are paying off for volunteers on Silver Lake in Waukesha County. With EWM present in their lake, they began participating in the Clean Boats, Clean Waters education program to prevent another invasive from coming in. They've also been carrying out an ongoing monitoring and hand-pulling effort in the shallow water area.

"That area is now nearly completely free of Eurasian water-milfoil and the native plant community has thrived," says Nate Rice, who has coordinated the volunteer effort.

This year, SCUBA divers will remove the EWM plants by hand in a deeper water location. The project, planned for the next three years, is supported by the Southeastern Wisconsin Invasive Species Consortium, Inc., and will be carried out entirely by volunteers, from SCUBA divers and kayakers with skimmer nets, to those aboard a pontoon boat collecting the bags of pulled plants.

"Start small. Think big," Rice says. "We are fortunate to have a limited number of areas on our lake that are infested with Eurasian water-milfoil. This makes hand-pulling the best choice for our lake, especially given a committed group of volunteers.

"Also, as we've learned from the experts, to be realistic, follow up, continue prevention and education efforts and stay informed about best practices and new invasives to watch out for," Rice adds.

DNR Lakes Specialist Heidi Bunk says the volunteers stand a good chance of controlling EWM in their lake.

"Aquatic plant management doesn't have to always be flashy. It's small, but effective steps, one at a time," she says.

Other southeastern Wisconsin lakes Bunk's worked with, like Delavan Lake in Walworth County and Pewaukee Lake in Waukesha County, have embarked on watershed approaches that involve scores of partners working over hundreds of square miles.

"This is a big job, a long-term approach, one that takes real collaboration with nonprofits and government entities," says Koepp. "Heidi Bunk has been great to work with and Bob Wakeman (DNR's aquatic invasive species coordinator) is also instrumental as they truly understand and care about the lakes in our area — they are not thinking about what some people think is a quick fix."

"The truth is nothing is broken, we simply have an ever-changing ecosystem that needs some serious attention and management," explains Koepp, who fully understands the effort needed to maintain a healthy lake. "I don't use hope in my equation. This WILL happen. It is working and the momentum is gaining. Our lake is going to get better and better." ■

Lisa Gaumnitz is a former public affairs manager for the DNR's Office of Communications.

PARTNERING FOR PEWAUKEE LAKE

SUBMITTED BY TOM KOEPP

Pewaukee sixth graders helping remove debris from the Pewaukee River.

SUBMITTED BY TOM KOEPP

One of the mechanical harvesters the district uses to remove invasive plants.

Managing a lake and its watershed can be a big task, involving numerous partners working over hundreds of square miles. For Pewaukee Lake in southeastern Wisconsin, here's some of what that management looks like:

- The Town of Delafield has a zoning and open space requirement that allows rain water and snowmelt to soak into the ground. This filters out pollutants, keeping them from entering the lake.
- The Village of Pewaukee provides a site for a shared conveyor belt to handle harvested plants, and the district returns the favor by picking up aquatic plants that village residents pile on their shores.
- The Lake Pewaukee Sanitary District is teaming with the DNR to acquire wetlands through Lake Protection Grants; the Pewaukee Kiwanis and Pewaukee Water Ski Club are raising money to maintain those wetlands and to add educational boardwalks; and the Pewaukee Women's Club is donating money to re-establish native prairies on the wetland fringes.
- The Pewaukee Chapter of Walleyes For Tomorrow installed the first "Fish Sticks" project in southeastern Wisconsin this past winter, anchoring felled trees to the shoreline to add more woody habitat for fish as part of multiple efforts to boost walleye populations in the lake.
- The Pewaukee River Partnership is working with the district on projects along the Pewaukee River and conducting stream monitoring on the creeks flowing into the lake.
- The district received a Waterways Commission Grant to buy two new harvesters and a trailer/conveyor, which will allow an increase in the volume of Eurasian water-milfoil and other invasive aquatic plants removed from the lake.
- The district, using DNR Lake Protection Grant funds, purchased a wetland with some uplands that will allow space for harvested plants to be turned and decomposed before being spread on farm fields.

Before engaging in any aquatic plant management or nuisance control activities, property owners and lake groups are encouraged to contact their local aquatic plant management coordinator to make sure they are following all the requirements. Many aquatic plant management activities require a permit before implementing.

For a list of coordinators, DNR planning and protection grants, required permits, volunteering opportunities, recent research and more about native and invasive plant species, go to dnr.wi.gov and search "Aquatic Plants."

BOB KORTH

MANAGING AQUATIC PLANTS TOGETHER

The DNR works with many partner groups and volunteers to keep our lakes healthy.

Wisconsin Lakes Partnership
dnr.wi.gov/lakes/lakespartnership/

UW-Extension Lakes
uwsp.edu/cnr/uwexlakes/

Wisconsin Lakes
wisconsinlakes.org

Clean Boats, Clean Waters
dnr.wi.gov/lakes/cbcw/

Citizen Lake Monitoring Network
dnr.wi.gov/lakes/CLMN/

River Alliance of Wisconsin
wisconsinrivers.org

Articles: Lisa Gaumnitz, Susan Knight, Carroll Schaal, Scott Van Egeren, Eric Verbeten, Kelly Wagner.
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PUB SS-1134 2014

Designed by Thomas J. Senatori
Printed by Schumann Printers
Cover photo: Frank Koshere

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